

Haptic Interfaces Using Electro-Rheological Fluids

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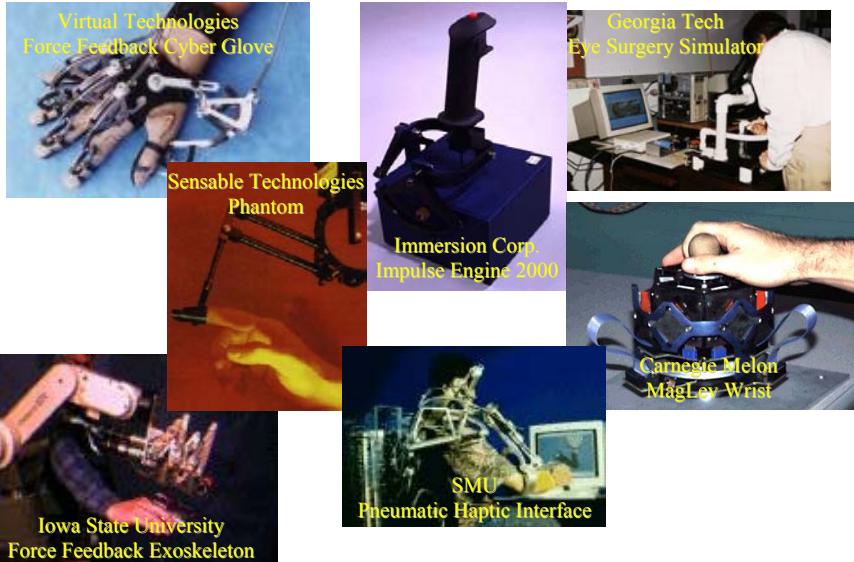
Motivation – Applications for Haptics

- New Mode of Input
 - Add sense of touch to visual and auditory systems
- Immersive Virtual Reality
 - Entertainment
 - Training
- Tele-Robotics
 - Send robots into unsafe environments
 - Remote surgery
- Force/Tactile Simulation
 - Rehabilitation
 - “Visualization” systems for blind people



Robonaut – NASA JSC

Haptic Interfaces



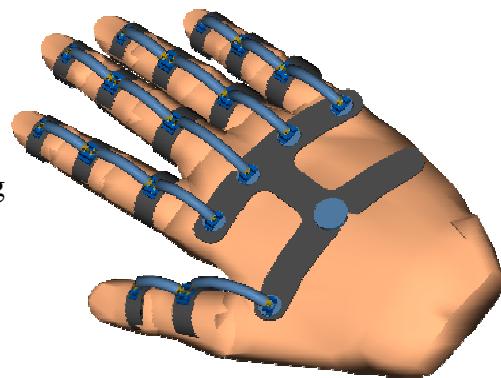
<http://haptic.mech.nwu.edu/intro/gallery/>

Challenges To Be Overcome

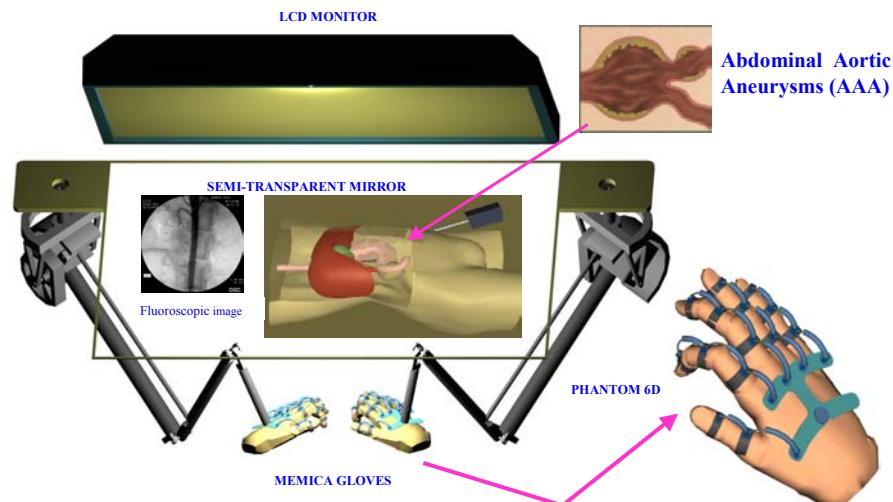
- Improved Devices: Light, Compact, Intuitive, High Bandwidth
- Miniature, High Performance Sensors and Actuators
- Stability Issues for Control System
- Accurate Mirroring of Remote Compliance and Damping

MEMICA: MEchanical MIrroring using Controlled stiffness and Actuators

- Project Seeks to Develop a Wearable Haptic Device for Use in Virtual Reality and Tele-Robotics
- MEMICA Allows Mirroring of Remote or Virtual Compliance, Damping and Forces using an Electro-Rheological Fluids (ERF) Based System



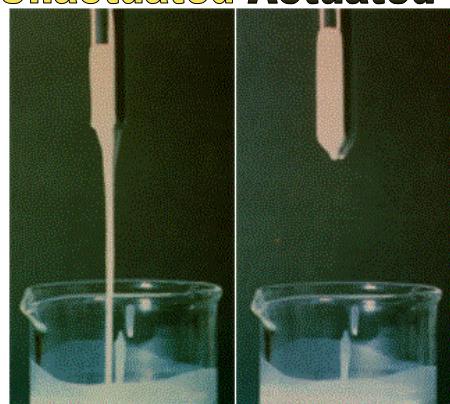
Performing Virtual Reality Medical Tasks via the MEMICA Haptic Interface



Electro-Rheological Fluids (ERFs)

Unactuated Actuated

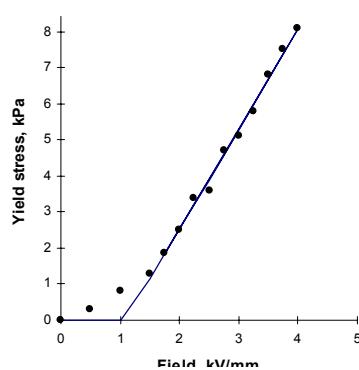
- Suspensions of particles in an insulating base fluid
- Changes viscosity when subjected to an electric field



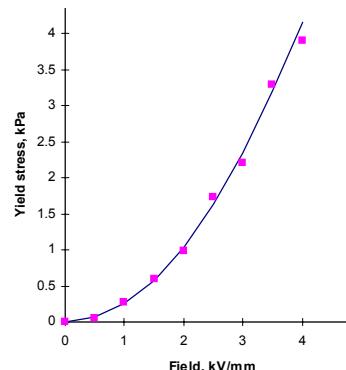
“LID 3354” ER Fluid

35% of polymer particles in a flourosilicone base oil

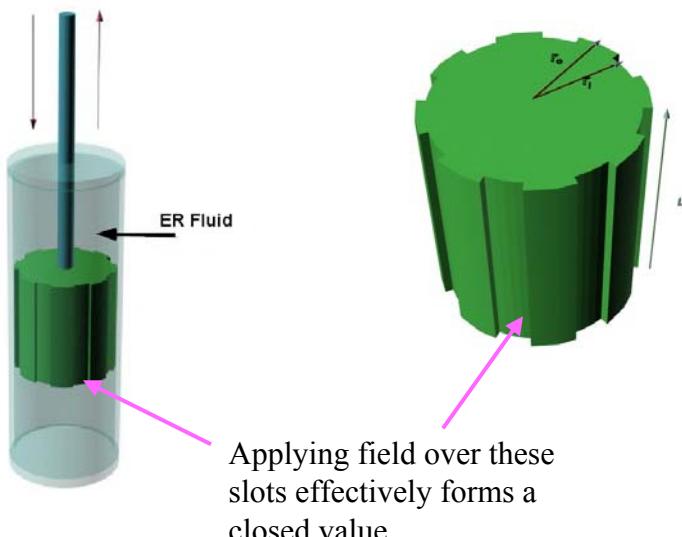
Static Yield Stress



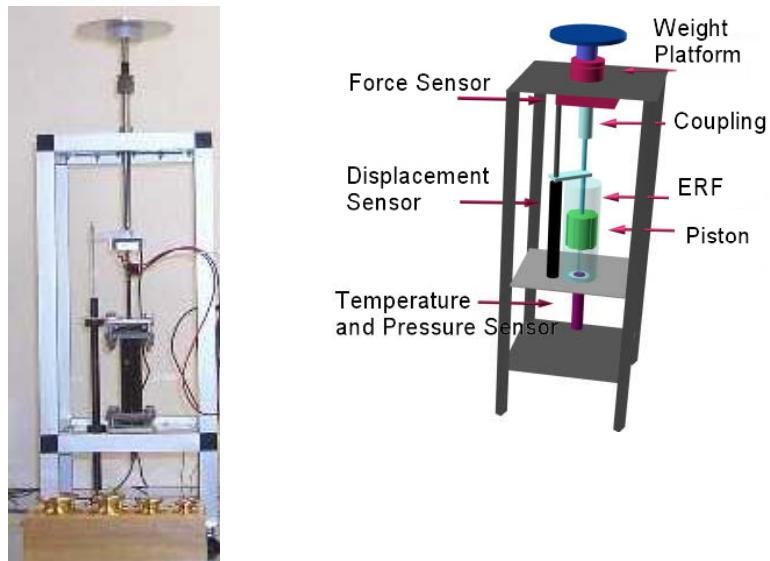
Dynamic Yield Stress



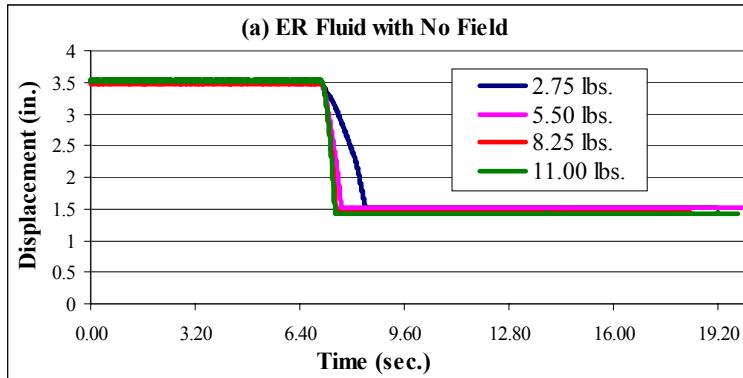
Electrically Controlled Stiffness (ECS) Element



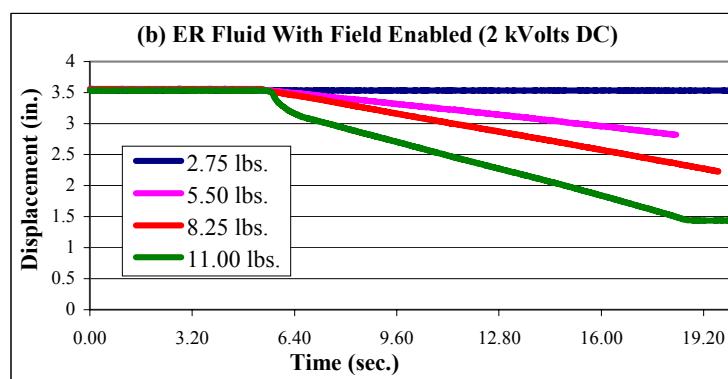
ECS Experimental Set-up



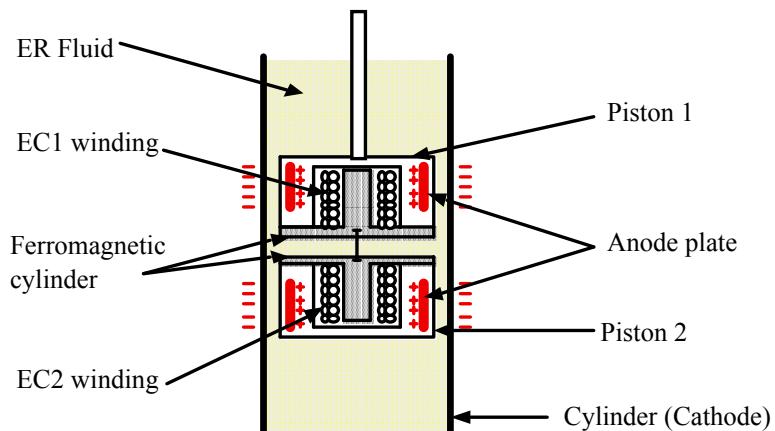
Experimental Data: No Field



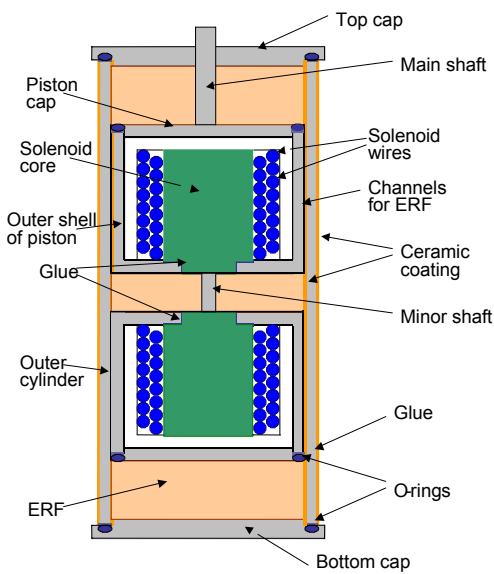
Experimental Data: With Field



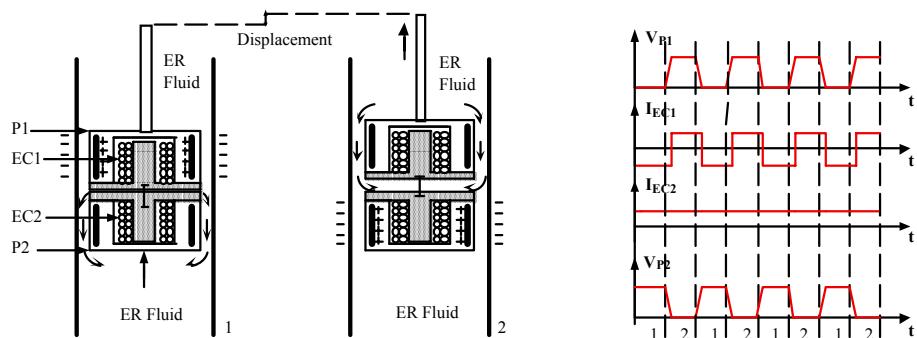
Electrically Controlled Force and Stiffness (ECFS) Actuator



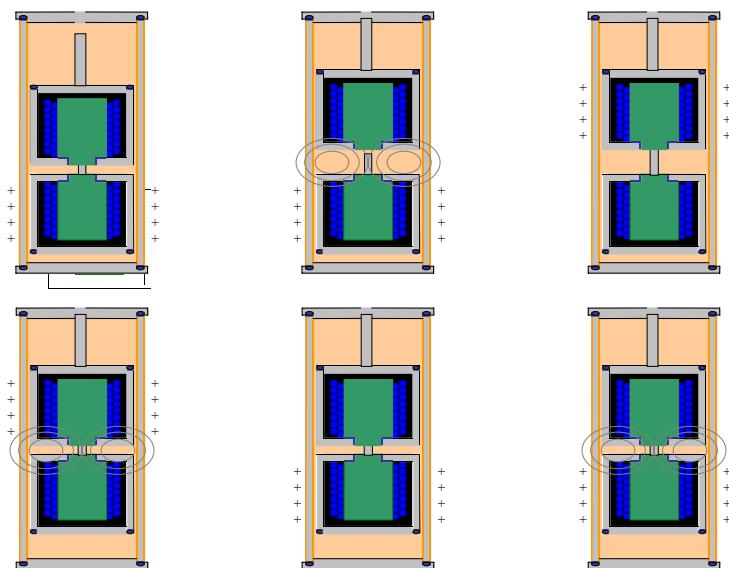
ECFS Actuator - Components



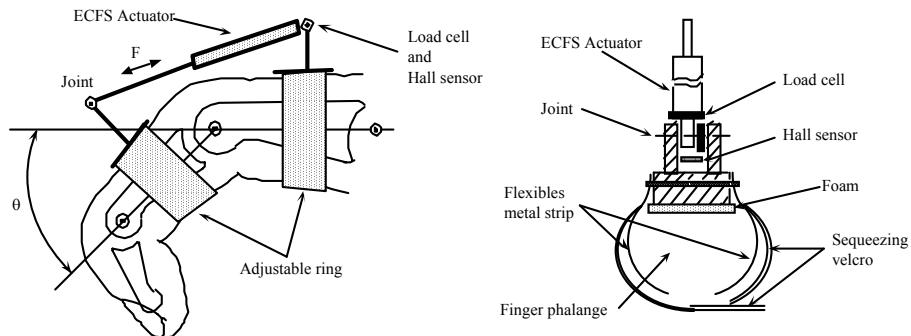
Inchworm Motion of ECFS Actuator



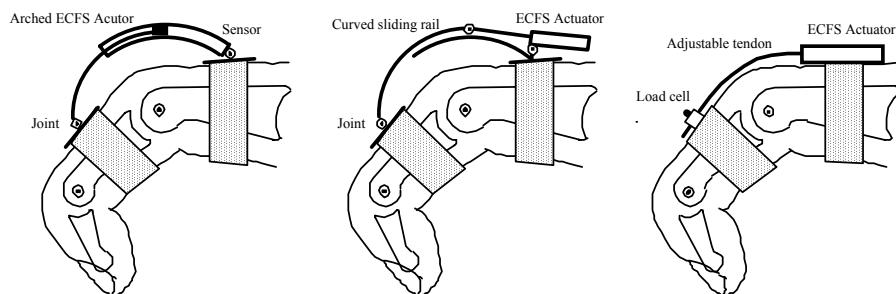
Inchworm Motion



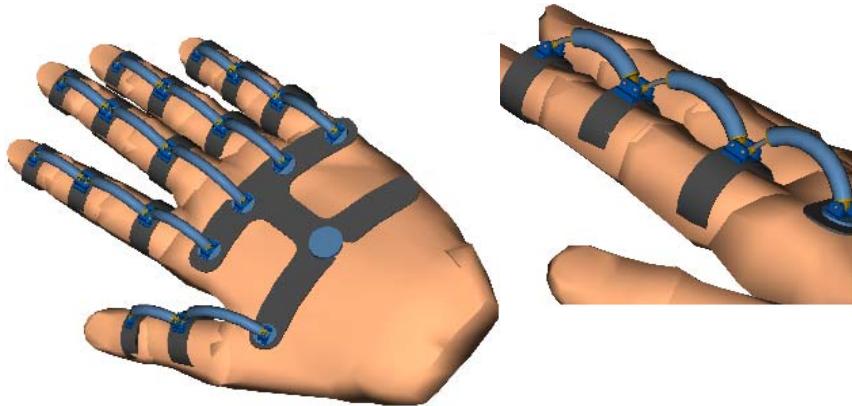
Mounting of ECFS Actuators on Fingers



Different Exoskeleton Mechanisms



ECFS Actuators on a MEMICA Glove



MEMICA System Overall View

Integration of MEMICA with
ReachIn Display and PHANTOM
Devices



Current Work

- ERF Based Haptic Interfaces for Vehicle Control
- ERF Based Exercise Equipment for Astronauts

Contributors

Current Members

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Sarah Young

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